

Do the processes in near-earth space influence on weather and climate?

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ABSTRACT

The validity of the point of view about predominance of the influence of solar activity on the Earth's climate is shown. Complex and spatially inhomogeneous meteorological parameters dynamic changes including temperature, correlate with Space weather parameters. A straight dependence of the surface temperature from Solar activity, as it was in epochs of Grand Minima of Solar activity, allows us to construct the temperature prediction in accordance with solar activity forecast for the XIX century. It leads to the conclusion about soon next temperature decrease period on a global scale, in contrast to the predictions global warming.

Keywords: Solar activity; the impact of near-Earth Space on weather and the Earth's climate; forecast of climate change.

Now, when the International Committee on Climate Change at the United Nations (IPCC) stated that the increase in global temperature in the last decade does not occur, it is worth to pay attention to alternative prognoses of climate change. This raises the question about the significance of human influence on climate. Meanwhile, the importance the impact on the complex climate system of the planet belongs to variations in Solar activity. During many centuries, the Earth's temperature is highly significant correlated with changes in the Wolf numbers and indices of magnetic activity [1]. The impact on the climate by other channels may appear unlikely because in this case, the energy brought into the atmosphere is on three orders smaller by magnitude than energy contained in the tropospheric circulation and synoptic processes. However, such ultra-weak influence, according to an alternative forecast, should lead to a cooling in the first manifestations just after the current maximum of solar activity. Maximum of cooling (about 0.5 degrees in global temperature) will occur, probably around 2040 (fig. 1) [2].

Climate is a long-term weather regime. However are there proofs the impact of Solar activity manifestations on the weather? From the comprehensive literature on the subject, one can cite some examples:

- Changes in interplanetary magnetic field polarity always lead to a decrease in the atmospheric vorticity index;
- Magnetic storms with a sudden commencement are accompanied by the growth of the variance in the day to day difference of atmospheric pressure of the global network of meteorological stations;
- A day later the large Solar flares the average index of cloudiness significantly increases at the mid latitudes.

It is clear that this kind of short-term effects in the summation is able to affect the climate. The weak point in the justification of the importance of solar-terrestrial relations in their influence on climate dynamics is a lack of theoretical explanations of many well-established empirical regularities. Why, for example, climatic indices correlate well exactly with variations of the duration of the classic 11-year Solar activity cycle [3]? How to understand that the earth's atmospheric temperature depends from the level of magnetospheric disturbance [4]? For this reason, and because of the complexity of the climatic system, all variants of currently available theoretical descriptions of upcoming cooling are only rough approximations. It is clear that their rather complete review requires a special presentation. In the most general terms, a panoramic picture of mechanisms was developed a quarter-century ago [5]. It turned out that the most important feature of it – the external influence of Solar activity on the climate – is realized by the several channels:

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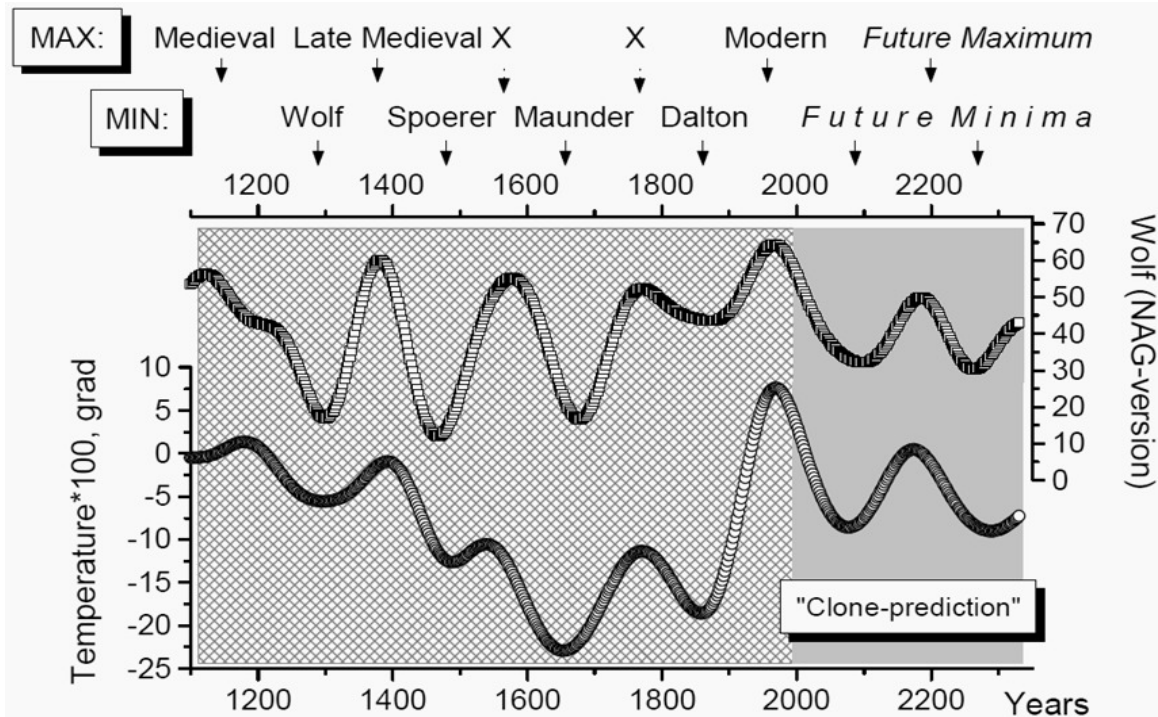


Figure 1. The Grand maxima and minima of solar activity and global temperature of the Earth: the last millennium and the forecast for the next three centuries [2]

- Variable flux of Solar ultraviolet radiation and X-rays affect the ozone layer (and thus - on the temperature field of the upper atmosphere); it controls the ionosphere (which indirectly affects the cloudiness); the Solar cosmic rays also affect the state of the top cloudiness on the high latitudes;
- The solar wind with its interplanetary magnetic field controls the state of the magnetosphere, which indirectly affects the circulation of the uppermost layers of the polar atmosphere; at the same time throughout the solar system, there are variations of galactic cosmic rays, that affects the state of cloudiness and the global electric field;
- The impact of ultra-weak agents mentioned above, is especially effective for certain geographical regions, so that the solar-atmospheric interactions imply planetary spatial organization [6];
- Some researchers attach great importance to the fact that "climate machine" is a multi-level oscillatory system [7]; thus, the link of climate with Solar activity is also possible by the synchronization and resonances. Periodic component in the variation of climatic parameters is well known since time immemorial. The periods of about two years, 60 years, 33 years are most mentioned among others. It is worth mentioning that for the first time the Solar Bruckner cycle of about 33 years was discovered in climate variations.

As a result, the global temperature is a function of a large number of cosmophysical and geophysical parameters. By the way, the contribution of greenhouse effect into this relationship is quite modest (its correct interpretation is described in [8]).

However, it is not possible yet to calculate the amplitude of global cooling yet enough precisely. It should be based on empirical data: with decrease in the level of Solar activity during Grand Minima, the global temperature decreased by about 1 Celsius degree [9]. The influence of Solar activity on the atmosphere is a common phenomenon for whole Solar System: for example, the ice situation in Arctic correlates positively with the square of polar caps of Mars (it is not important that they are only hoarfrost...); the details of giant vortex in Jupiter atmosphere (Great Red Spot) depend from Wolf numbers; there is a 27-day Solar period in the atmospheres of Earth, Uranus, Neptune.

Therefore, the most common idea about the impact of Solar activity to global temperature is its direct influence . In Table 1 there are some prognoses of Solar activity are summarized along with brief remarks about the approach of prognosis.

Table 1. The forecast of Solar activity for the 21st century, according to different authors.

Author(s), source	Main idea of forecast approach	Probable start of decrease in Solar activity (years)	Comments
R. Fairbridge, I. Shirley [10]	The orientation of the Sun's orbit relative to the barycenter of the Solar system	2014 and 2050	
O. Mikushina et al. [11]	Analysis of cyclic solar activity, reconstructed by C ₁₄	After 2000	Found periods confirmed by subsequent researches
F. De Meyer [12]	Fundamental period 22 years is modulated in amplitude and phase by the set of periods. The forecast is made by extrapolation.	After 2015	
V.G. Sarychev [13]	The original algorithm of signal recovery from the spectral evaluation of the classic time series of Solar activity	After 2020	Specially built prognosis
B.P. Komitov, V.I. Kafitan [14]	Analysis of long-term rhythms in Solar activity	2012 and 2025	Specially built prognosis.
H. Abdusamatov [15]	Analysis of the luminosity variations according to the data of last few decades	2012-2013	
V.I. Ermakov et al [16]	Variations in solar activity according to D.J. Schove time series represented as modulation of 11-year cycle of Solar activity. The forecast is made by extrapolation.	First half of XIX century	
Yu.A. Nagovitsyn, M.G. Ogurtsov [2, 17]	Spectral analysis of the restored dynamics of Solar activity during the last 1000 years.	2040	

Thus, the research of Sun-weather and Sun-weather-climate-mankind correlations should be enhanced. At an early date it is a very important while studying archive and geological data, to clear which geographical regions became the “poles of cold” during previous Grand Minima of Solar activity.

The work within the framework of improving the competitiveness of TSU.

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